

External Science Review Questions

1. Is the justification for flow augmentation clearly stated?

Yes. The rationale given is to re-establish moderate high flows with the goal of re-initiating sediment transport and channel migration through providing for "channel morphology maintaining" flows. The need for flow augmentation is established by both comparing pre- and post-dam hydrologic regimes (which document the reduction in moderate high flows) and discussing the effects of the reduction in these flows on channel and riparian processes and dynamics, as well as the resulting effects on salmonid habitat.

2. Are the goals and objectives clear and reasonable?

Yes. The goals of the proposed flow augmentation are stated clearly on page 27 of the conceptual proposal: (1) increase quantity and quality of habitat that support salmonids; (2) promote floodplain development and channel migration processes; and (3) promote appropriate riparian vegetation recruitment and growth. While these goals are rather general, the proposed monitoring program should allow more specific, detailed goals to be elaborated during the project.

3. Is there a clear conceptual model to support the proposed action?

Yes. The proposal to re-introduce "channel morphology maintaining" flows by releasing discharges that correspond to the pre-dam 1 to 3 year recurrence interval flows is founded on the well established geomorphological idea of channel forming flows, as well as empirical data (i.e., observations and reports) for the flows needed to achieve the desired changes (gravel recruitment and transport, channel migration) in lower Clear Creek.

4. Are the key assumptions and scientific uncertainties explained?

Yes. Scientific uncertainty is addressed at length on page 25.

5. Are the hypotheses to be tested clearly stated?

Yes, although they are somewhat vague. The general types of response are predicted, but the magnitude of response is to be determined

by monitoring. In other words, as they are stated in the conceptual proposal the governing hypotheses are cast as ones of direction of change (e.g., more spawning gravel), rather than as a forecast of how much change (e.g., 10% more spawning gravel). However, Table 8 lays out a very rational way to structure a monitoring program to document the extent of changes resulting from the "experiment" of moderate high flow re-establishment. Moreover, there is little theory to guide the development of more specific detailed predictions, something that would make a well documented experiment such as the one proposed in the conceptual proposal very valuable for the science of restoration geomorphology.

6. Is the conceptual study design component appropriate?

Yes. The approach of designing for "channel morphology maintaining" flows is consistent with current geomorphological and ecological understanding of West Coast river systems.

7. Will the conceptual monitoring/data gathering program answer the questions posed by the hypotheses?

It could, depending on the funding level and what is actually done under the monitoring program. Table 8 outlines an excellent, though ambitious, plan for monitoring channel response to the proposed increase in moderate high flows. As will all such efforts, however, the Devil is in the details, which could only be addressed in a full proposal.

Overall evaluation summary rating:

Recommended for full proposal development.

Brief explanation of summary rating:

The approach proposed in the conceptual proposal is based on sound theory, both geomorphological and ecological, in terms of re-establishing key fluvial processes that create and structure in-stream and floodplain habitats. It is a very reasonable approach that follows along the lines that current understanding would predict would be needed in order to achieve the desired results (from a habitat perspective at least). In my opinion, the key weakness of the approach is that flows which increase the mobility of gravel in a system with a shortage of gravel will mean that the long-term success of the approach will depend on continued gravel augmentation in order to avoid a progressive loss of gravel. The importance of this issue is addressed

explicitly in the conceptual proposal, as is the uncertainty associated with potential gravel inputs from mass wasting. The monitoring and adaptive management portions of the proposal should lead to both local understanding (which can be used to update the plan) and to regional insight (which can perhaps help with other future projects). In summary, I find this to be a very solid conceptual pre-proposal and recommend proceeding to the development of a full proposal.

Sincerely,

David R. Montgomery
Dept. of Earth & Space Sciences
University of Washington

Conceptual Proposal Review Form (External Science Review) CBDA Environmental Water Program

Directions: Please use this form to record your evaluations. The review form contains a number of questions and asks you to provide an overall summary rating (Recommended for full proposal development, Not recommended for full proposal development) for the proposal. Please provide a narrative answer for each of the questions. Your entries should explain your evaluation, but do not need to be in complete, grammatically correct sentences. Please remember that these reviews will be available to the public on the EWP website. When your review is complete, please save it as a new Word file, using the following naming convention: first initial, last name, Clear Creek, the words "external science review", and extension (i.e. wsears clear creek external science review.doc). Completed review forms should be e-mailed to Stefanie Brearley (SBrearley@sanet.com, phone 916 737 3000). If you have further questions regarding the review or the document please contact Campbell Ingram (Campbell_Ingram@fws.gov, phone 916 414 6727) or Peter Downs (downs@stillwatersci.com, phone 510 848 8098 x138).

Proposal Title: Environmental Water Program Pilot Flow Augmentation project: Concept Proposal for Flow Acquisition on Lower Clear Creek

Reviewer: Jim Lichatowich

External Science Review Questions

1. Is the justification for flow augmentation clearly stated?

In general the justification for the flow augmentation as part of a narrowly defined experiment is adequate. The justification could have been more succinct. It seemed to be in pieces in various parts of the proposal. On page 21 there is this statement: "As described in the Statement of the Problem (Section 1.5), the fraction of fines in incubation habitats appears to pose such a problem." I could find no section 1.5 or a section titled Statement of the Problem. Such a section would have been the logical place to pull together and present all the information that justifies the project.

2. Are the goals and objectives clear and reasonable?

The goals and objectives as stated for the concept proposal are adequate, however, they have a shortcoming that should be corrected in the full proposal. The objectives state in general terms what is being attempted, but they leave it up to the reader to infer what success will look like. For example, Objective b. under goal 1 states "Increase the area of low-velocity channel-margin habitat for rearing Chinook and steelhead fry (reaches 1, 3, 4)." What constitutes success relative to this objective? Will an increase in one square

foot of low-velocity habitat constitute success? In the full proposal the objectives should give a clear description of success and a standard for determining if it has been met.

3. Is there a clear conceptual model to support the proposed action?

The conceptual model and its variants support the proposed action. The proposal identifies Clear Creek as the target ecosystem (page 3) and the conceptual model clearly addresses actions and process at that geographical scale. However, the focal aquatic species are anadromous (Chinook salmon and steelhead), which means the ecosystem that must be taken into consideration extends way beyond the confines of Clear Creek. Whether or not Clear Creek can increase the abundance of Chinook salmon and steelhead following implementation of the proposed flow regimes depends on the quality of the resulting habitat and its effect on survival and the cumulative survival of Chinook salmon and steelhead throughout the ecosystem where they complete their life histories. The proposal recognizes that there are factors outside clear creek that influence survival of the Chinook salmon and steelhead, but beyond that recognition it ignores those factors. At a minimum those factors should be reviewed as part of the conceptual model to determine if the cumulative effects of mortality factors outside Clear Creek will reduce or negate the anticipated benefits of the likely habitat improvement in Clear Creek. Its my understanding that life cycle models that could provide most of the information needed to make this determination are being developed or have been developed for anadromous salmonids in the Sacramento Basin.

I realize the focus of this project is Clear Creek and most of the effort and attention must be focused there. However the project cannot claim to take an ecosystem approach if it fails to take into some consideration most of the ecosystem that the focal aquatic species occupy.

4. Are the key assumptions and scientific uncertainties explained?

Assumptions regarding the proposed actions are mentioned on pages iv, 6 and 36 of the proposal, but I am sure those three assumptions are not the only ones that underlie the conceptual model and the project. Several assumptions are implied in section 4. 2. 1. (page 20). The key assumptions should be explicitly described in a section dedicated to that purpose.

The uncertainties of flow augmentation are thoroughly discussed in section 4.2.2. This section is well done as far as it goes. One of the key uncertainties not stated in the proposal is related to my comment in the previous question. Can the expected habitat improvement in Clear Creek overcome the mortality factors external to Clear Creek and result in an increase in abundance of the aquatic focal species?

The list of uncertainties provided in the proposal (page 25) suggest that the limiting factor or factors for anadromous salmonids in Clear Creek are not known. This calls into question the decision not to rely on an evaluation of biological response (increased abundance of salmon and steelhead, for example), and rely instead on an evaluation of the physical responses. A physical response such as an increase in the amount of low velocity rearing habitat, while showing a measure of success may not remove the constraints on production of salmon and steelhead in Clear Creek. The existing biological information on the aquatic focal species should be analyzed to determine which habitat/life stage is likely limiting production of salmon and steelhead in Clear Creek.

The authors explain the lack of monitoring for a biological response by stating on page 5 "... the project is an experiment which will be limited in scope and timeframe by available resources." Then on page 38 they propose generally assessing the potential biological response to habitat change using generic habitat requirements of the focal aquatic species. The authors state: "Certainly, the body of knowledge of the habitat requirements of target species (particularly for salmonids) is extensive and provides a sound basis for generally assessing responses to changes in habitats (i.e., increases in the quality and/or quantity of life-stage specific habitats)." The authors probably meant quality and/or quantity of habitat. While it is possible to derive a generic set of habitat attributes required by anadromous salmonids, their use in assessing the effects of habitat improvement schemes ignores the importance of unique variations in the habitat/life history relationship in individual watersheds. While it is possible, for experimental purposes to abstract the physical processes from the biological context in a watershed, at some point establishing the relationship between the physical processes and attributes and a biological response in the specific stream is necessary. The authors should state how and when that will be accomplished.

5. Are the hypotheses to be tested clearly stated?

With the exception of macroinvertebrate sampling and its related hypothesis there are no hypotheses listed in table 8 that require monitoring of biological responses. However biological monitoring is included in the program and listed in the budget for substantial funding. For example, spawning surveys and observational surveys for utilization and potential stranding will consume a total of \$464,000. To be effective and useful the biological monitoring should be designed to test specific hypotheses.

The authors of the proposal should consider extending the project beyond ten years so meaningful biological responses to the habitat changes can be determined.

On pages 22 and 23, the authors note the potential for detrimental effects resulting from the experimental flow releases. Those possibilities should be listed as uncertainties and hypotheses that will be evaluated through the monitoring program.

6. Is the conceptual study design component appropriate?

The study design was appropriate given the narrow scope of the experiment. The scope needs modification to address the concerns raised above. In the full proposal, some modification to the study design will be necessary (duration of the study, for example) to address the concerns raised above.

7. Will the conceptual monitoring/data gathering program answer the questions posed by the hypotheses?

The answer to this question requires the kind of details that should be included in the full proposal. From a conceptual standpoint the kind of data collection described seems to be adequate to answer the questions posed in the proposal. My earlier comments suggest there are uncertainties and questions that are not included in the proposal that should have been. Those questions obviously are not addressed by the proposal. They should be dealt with in the full proposal.

Miscellaneous comments:

Please provide an overall evaluation summary rating below.

The conceptual proposal should proceed to development of the full proposal.

Provide a brief explanation of your summary rating:

Overall the proposal was well done and justifies proceeding to the next step of a full proposal. The shortcomings I identified are not fatal flaws and they can be corrected in the full proposal. Specifically the authors need to give more attention to monitoring and evaluating the biological response in Clear Creek. The use of generic habitat attributes for salmonids is not an appropriate way to evaluate the biological response. The approach in this proposal is similar to the "Normative River " concept developed by the Independent Scientific Group for the Columbia River (Independent Scientific Group. 2000. Return to the river:

Restoration of salmonid fishes in the Columbia River ecosystem. Doc. 2000-12. Northwest Power Planning Council, Portland, OR.) The approach could prove to be very useful. It needs to be given a thorough evaluation.

Proposal Title: Environmental Water Program Conceptual Proposal for Flow Acquisition on Lower Clear Creek

Reviewer: Dr. Nicholas G. Aumen

External Science Review Questions:

1. Is the justification for flow augmentation clearly stated? Yes, proposal does an excellent job of making the case for mid-range flow augmentation intended to improve habitat.
2. Are the goals and objectives clear and reasonable? Yes, in fact I think some of the goals are understated, and have pointed those out in my comments below.
3. Is there a clear conceptual model to support the proposed action? Yes, I support the development and continued refinement of the conceptual models presented in the proposal. Those types of models are a cornerstone of our Everglades restoration efforts.
4. Are the key assumptions and scientific uncertainties explained? Yes, the proposal outlines the key assumptions and uncertainties in a clear way. I particularly support the assumption that habitat restoration is the best surrogate for ecological restoration. This approach has proven successful so far in the Everglades.
5. Are the hypotheses to be tested clearly stated? Yes, and I particularly appreciate the summary of hypotheses, performance measures, and monitoring methods in Table 8.
6. Is the conceptual study design component appropriate? Yes, the focus on physical parameters that would suggest habitat improvement are appropriate.
7. Will the conceptual monitoring/data gathering program answer the questions posed by the hypotheses? Yes, although I have a concern about the cost estimates for monitoring, which may be significant underestimates.

Miscellaneous comments:

Please see general and specific comments below. My largest general concern is the apparent lack of an explicit management/policy component.

Please provide an overall evaluation summary rating below:

Recommended for full proposal development

Provide a brief explanation of your summary rating:

I found this proposal to be extremely well written and comprehensive in its scope. It is clear to me that extensive work went into the preparation of this pilot proposal, and there were almost no stones left unturned (no pun intended). The plans for the duration, magnitude, timing, and frequency of these mid-range flows seem well founded. I support the “weight-of-evidence” approach for the science. I also like the idea of this concept proposal preceding a full-blown proposal.

General comments:

I am basing my review on my experiences with adaptive management associated with the various Everglades restoration projects. In particular, the Comprehensive Everglades Restoration Plan (CERP) has a large adaptive management component and budget, including \$100-million over 10 years to implement a monitoring and assessment plan to provide the scientific feedback for adaptive management. It is important to note that our adaptive management concept is slightly different than what is being proposed for Clear Creek. Our restoration alternatives have already been selected via a multi-year process involving scores of stakeholders in the region. We are using adaptive management (actually adaptive assessment) to follow the outcomes of these restoration projects as they come on line, and to provide the scientific feedback from which to make any necessary changes in direction. Another interesting parallel between CERP and Clear Creek is the assumption that ecological benefits will follow improvements in habitat. In CERP, the assumption is that restoration of hydrology (“getting the water right”) will result in overall ecological restoration.

Based on my experiences, I worry about one potential shortcoming in this concept proposal – the lack of a clear policy/management component. I formed the distinct impression that this document, while excellent, was prepared solely as a scientific/technical document. The heart of adaptive management is the feedback of scientific information to decision makers to provide them with the opportunity to change restoration programs should initial results dictate. You may have left the decision makers out of the process. Because there certainly must be key policy/management boxes in the adaptive management flow chart, the corresponding representatives of these boxes must be an integral part of concept development from the very beginning, and the proposal should contain major sections addressing policy/management issues and obstacles. In the Everglades case, my largest worry is that even if there is a solid scientific foundation suggesting even a modest change in direction, there will be little if any appetite for project change requests that will delay the projects and that will almost certainly cost more money than originally projected. If the key policy makers and/or managers have been a part of this concept development from the very beginning, there is a much greater chance that they will be supportive if changes are needed later on.

The lack of this policy component was evident later in the proposal (p. 44). A part of one paragraph is dedicated to issues such as the potentially competing requirements of flood management, hydropower, water supply, water quality, and fishery mandates. Almost any one of these issues has the potential to bring Everglades restoration to a grinding halt! The balancing of competing needs has consumed the vast amount of our time and

resources during restoration planning, and I am concerned that they are being given short shrift in the Clear Creek concept proposal. Another place in the proposal where management input is vital is p. 47. Ecosystem outcomes and feedback are where the managers and policy makers need to be tightly connected to the adaptive management process.

Finally, I would like to relate an example from our Everglades experiences that pointed out the need for management and policy-level involvement early on. After months of work by a large technical committee formulating our adaptive management approach, we conducted two workshops to get additional input. The second of these workshops was the first time we included higher-level management and policy folks. Some of our ideas – second nature to us by this time – were greeted with a fair amount of healthy skepticism from those not involved in the process. One remark I remember well was when a Washington-level Corps of Engineers staff person asked in a breakout group, “Where in this process has NEPA and its constraints been included?” We did not have a good answer. Will there be a NEPA process required for the Clear Creek pilot project?

Another general comment relates to looking beyond this pilot project. I would have liked to have seen some speculation about future restoration actions based on a suite of various outcomes of the pilot project. In particular, what is the current thinking about expanded flow augmentation projects in Clear Creek or other locations if the pilot study results are positive? What might be done differently if the results are negative? I believe this type of forward thinking will greatly increase the chances for success.

Finally, one significant caution – On p. 37, other long-term status and trend monitoring is mentioned that is conducted outside of this project. The assumption is that this monitoring will continue and will always be available to augment the data collected under the Clear Creek project. In the Everglades, we made similar assumptions, and those assumption have not proven to be good. Budget cuts already have resulted in cutbacks of monitoring that we were depending on to augment our studies. You should have contingency plans to augment monitoring if that monitoring is in the critical path to success of the science.

Specific comments:

p. 3 – The phrase “...reactivate fluvial geomorphic processes” may be a little too general, and a little too jargon-like to best convey the goals of the flow augmentation. I don’t necessarily have a better suggestion at this point, but believe that some more thought should be given to this.

p. 19 – I understand why there is a focus only on salmonids and native floodplain trees as indicators. I think it might be more accurate to describe this focus as the best that can accomplished, given the resources available and the long time scales on which some of the ecological processes operate, rather than that they are good indicators of the rest of

the system. The latter statement requires some more supporting information that is available in the proposal.

p. 28 – Is it possible to conduct some simple hydraulic experiments to test flow ranges necessary to achieve the geomorphic goals? I certainly am not an expert in this area, but I wonder, given the scale and expense of the overall project, if there could be some more supporting information developed. These data may exist from previous studies, and if they do exist, should be cited. The observations of bed movement of various particle sizes during previous flow events do not seem comprehensive.

p. 28 Kimmerer et al. 2002 and last paragraph – I would not be a proponent of “miniaturized natural flow regimes” unless I saw studies that supported this approach. We have rejected this approach in much of our restoration efforts in south Florida. I also think the last paragraph on this page is a significant undersell of this pilot project. I do see it more as a “flow regime close to natural in some seasons.” Granted, it is only a portion of a larger flow regime, but it is a relatively large-scale ecosystem restoration project that will lead to significant increases in our understanding of flow dynamics and restoration ecology.

p. 29 – Again, for the non-geomorphologist, what is the significance of the 84th percentile diameter sediment?

p. 32, flow frequency – I would worry less about frequency than other parameters (e.g. duration, timing), because frequency probably is the component over which you will have the least control. Return intervals vary greatly in nature, and it probably would be counter-productive to over-analyze intended frequencies.

p. 35, #1 at bottom of page – I view this point more as a positive rather than a constraint. One would not want to pursue a watershed-scale flow restoration without the information that this pilot project will provide. Also, the smaller scale makes the science component more manageable.

p. 42 – I believe the use of, and the need for models is overstated (e.g., “Without the use of such models, our learning opportunities from this experiment are substantially limited.”). I do not believe that the success of this pilot study hinges on the use of models in any way. I view models as supporting, but not essential, tools for research and monitoring in the context of this proposal.

p. 47 – I think there are more recent examples of adaptive management examples and uses than are conveyed here. You may want to visit the webpage of the Collaborative Adaptive Management Network (<http://www.iatp.org/AEAM/index.html>) for some examples and ideas.

p. 49 – The total cost for monitoring seems low. It is hard to judge the estimate without more details. Will the work be conducted in-house by agencies, or contracted out? If the latter, it seems like the costs may be significantly underestimated.

p. 49 – Is there a component in the plan for publication and/or dissemination of results? I believe all projects of this magnitude must serve as a source of information to other restoration practitioners.

Title: Environmental Water Program Pilot Flow Augmentation Project: Concept Proposal for Flow Acquisition on Lower Clear Creek (August 2004)

Authors: Stillwater Sciences, 2855 Telegraph Ave, Suite 400, Berkeley, CA 94705

Reviewer: N.P. Hitt, Department of Fisheries and Wildlife Sciences, Virginia Tech

Review date: 2 September 2004

1. Overall, this proposal is good. The proposed project appears to be consistent with the goals of the CBDA and the EWP. The document presents a defensible rationale for flow augmentation as well as a reasonable adaptive management framework to evaluate the success or failure of the proposed actions. I appreciate the use of explicit, testable hypotheses in this proposal. Also, the focus on ecological processes (i.e., flow) for habitat management is valid and well described in this document.
2. Throughout the document, the authors should do a better job of addressing how the proposed actions relate to on-going habitat management and monitoring projects. For instance, the goal to “reactivate fluvial geomorphic processes” (pg. 3) should be described in conjunction with the “Lower Clear Creek Floodway Rehabilitation Project”. Because streamflow drives physical habitat dynamics, “rehabilitation” projects in the downstream reaches are closely linked with flow management. Clarification would help the reader in the introduction of this document.
3. A PVA of salmonids in Clear Creek would be useful. Given that 98% of the salmonid spawning habitat has been eliminated in Clear Creek (pg. 3), I have to question whether restoration in this area offers the most important regional benefit for salmonids. The introductory discussion suggests that this creek is regionally important, but this claim would be better defended with an analysis of the viability of salmonid populations in the context of the proposed actions.
4. The authors recognize the importance of water temperature for salmonid fishes, but do not sufficiently evaluate the potential effects of flow augmentation on water temperature.

Are the “glory hole” releases epilimnetic? How would seasonality and water temperature stratification in the reservoir affect salmonid dynamics?

5. The authors need to improve their considerations of groundwater – surface water interactions in this watershed as well as the effects of the proposed actions. Numerous recent studies have underscored the importance of groundwater dynamics for vegetation and salmonid dynamics (see attached list). The authors mention that groundwater sampling would be important, but do not explain why this is the case or what measures would constitute important thresholds for biota.
6. I appreciate the authors’ recognition of the uncertainty implicit in their proposal (pg. 5).
7. The second caveat mentioned on page 5 could also be addressed as the potential mismatch of scales: large spatial scale processes operate over large temporal scales (see Frissell et al. 1986). As a result, one would not expect to observe immediate biotic responses to the flow-mediated habitat alterations proposed here.
8. Consider Montgomery and Buffington (1997, 1999) for reach delineation parameters (pg. 7).
9. Further detail needs to be provided with respect to how the reference conditions were established (pg. 19). What are the assumptions implicit in these conceptual models? How were these assumptions tested?
10. The consequences of managing the (historically) alluvial reaches as single channel reaches should be explored. This issue is mentioned only briefly (pg. 19-20) in explaining why restoration goals do not include restoration of braided channels in the downstream reaches.
11. The objectives for goal #1 are good (pg., 27). However, the rationale for which reaches are targeted for each objective are obscure. Can the authors clarify the methods that determined how objectives were assigned across reaches?
12. Regarding goal #2, objective F, are these structures to be fixed in place in the stream? If so, how does this relate to the other objectives that utilize stream power to create habitat?
13. Regarding goal #3, flow timing should be considered in conjunction with vegetation (i.e., regeneration) goals (pg. 32). For instance, flow timing is a key component of cottonwood regeneration. Cottonwoods typically release seeds during the descending

limb of the hydrograph, resulting in the “stranding” of seeds along riparian zones with the dropping water levels. Considerations of seasonality should be considered in this regard.

14. An explanation of the rationale for “channel bed maintaining” and “channel morphology maintaining” flows would be useful (pg. 28).
15. The authors refer to post-dam flows of 4000-6000 cfs occurring once every 10 years. Is one flood in 10 years enough to accomplish the ecological goals in this proposal (pg. 28)?
16. I appreciate the empirical work done to evaluate flow model predictions with respect to substrate mobilization (pg. 30). However, the author should also consider sheer stress as a function of depth, velocity, and channel slope. At the minimum, the slope of the channel should be reported and interpreted as this strongly influences the capacity of substrate mobilization in streams. I suspect that these data were presented in McBain and Thrush (2001).
17. Consider Fausch et al. (2001) for a treatment of flow timing/magnitude issues with respect to rainbow trout (pg. 32).
18. A converse argument could be made (pg. 32) that high flows in the late spring could diminish YOY survivorship.
19. Regarding bullet #2 on page 33, this point should be treated as a hypothesis – not as an assumption. The proposed project is well-suited to test this hypothesis.
20. The authors should cite Popper with reference to the “refutation” criterion of science (pg. 38).
21. The authors are correct that measurement of biological responses (e.g., salmonid numbers) to flow alternations are difficult (pg. 38). Moreover, the potential mismatch between large spatial scale “treatments” (i.e., flow augmentation) and short temporal scales of observation introduce additional complications. However, the authors need to go further to incorporate biological monitoring into their proposal. Although the authors reference “on-going” USFWS and state-level monitoring, it is unclear how this work relates to the objectives in the proposal. The authors should discuss the on-going USFWS research and assess whether or not these data could be used to assess the importance of flow augmentation trials. Specifically, how many years of data (or salmonid generations) would be necessary to expect to see treatment effects? Where are control watersheds located? How are these data analyzed? If the planned studies of

lower-flow events will contribute to assessment of higher-flow events, this point should be made explicitly in the document.

22. The hypothesis testing framework on pages 40-41 should include a temporal component. Over what time scale are these hypotheses appropriately evaluated? (Link this to the discussion on pages 42-43).

Groundwater-surface water interactions

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Ward, J. V., K. Tockner, and F. Schiemer. 1999. Biodiversity of floodplain river ecosystems: ecotones and connectivity. *Regulated Rivers: Research and Management* 15: 125-139.

Effects of streamflow on fish

Bunn, S. E., and A. H. Arthington. 2003. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. *Environmental Management* 30: 492-507.

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Fausch, K. D., Y. Taniguchi, S. Nakano, G. D. Grossman, and C. R. Townsend. 2001. Flood disturbance regimes influence rainbow trout invasion success among five holartic regions. *Ecological Applications* 11: 1438-1455.

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Conceptual Proposal Review Form (External Science Review) CBDA Environmental Water Program

Directions: Please use this form to record your evaluations. The review form contains a number of questions and asks you to provide an overall summary rating (Recommended for full proposal development, Not recommended for full proposal development) for the proposal. Please provide a narrative answer for each of the questions. Your entries should explain your evaluation, but do not need to be in complete, grammatically correct sentences. Please remember that these reviews will be available to the public on the EWP website. When your review is complete, please save it as a new Word file, using the following naming convention: first initial, last name, Clear Creek, the words "external science review", and extension (i.e. wsears clear creek external science review.doc). Completed review forms should be e-mailed to Stefanie Brearley (SBrearley@jsanet.com, phone 916 737 3000). If you have further questions regarding the review or the document please contact Campbell Ingram (Campbell_Ingram@fws.gov, phone 916 414 6727) or Peter Downs (downs@stillwatersci.com, phone 510 848 8098 x138).

Proposal Title: Environmental Water Program Conceptual Proposal for Flow Acquisition on Lower Clear Creek

Reviewer: P.L. Angermeier

External Science Review Questions

1. Is the justification for flow augmentation clearly stated?
The authors make a strong case for augmenting flow in Clear Cr. Although much will be learned from the proposed experiment, it's not obvious that Clear Cr is the *best* place to invest in flow experiments relative to other potential systems.
2. Are the goals and objectives clear and reasonable?
Yes, but I suggest more emphasis on documenting biological responses to the flow augmentation (see below).
3. Is there a clear conceptual model to support the proposed action?
Overall, the conceptual model is clearly presented but many details should be added if a full proposal is developed. For example, the conceptual model provided little detail on the effects of temperature-flow interactions on salmonids or on how flow changes might affect the distribution/abundance of predatory *Micropterus* or other species that adversely affect salmonids. This latter omission seems especially important to rectify, given that introduced species are widespread and that their interactions with flow and salmonids are likely complex but poorly understood.
4. Are the key assumptions and scientific uncertainties explained?
The authors do a good job of explicating many assumptions and uncertainties. However, I do not completely agree with how they focused the proposed work in response to the uncertainties. In particular, the uncertainty associated with observing/detecting salmonid

responses to the flow experiment seemed to be used to justify avoiding much investment in monitoring potential salmonid responses. This tactic is ill-advised because the salmonids are what people care about most and are the component we have the most to learn about. I recommend identifying a few key metrics of fry and juvenile recruitment that are informative about population response, and *relatively* simple to measure. These should be measured annually. Although annual dynamics of salmonids are often erratic, the authors could more thoughtfully explore whether multi-year trends in salmonids can be linked to flow changes of the order proposed or whether existing data and ongoing restoration efforts offer any evidence that habitat changes (described on pp 14 and 16) have measurably affected salmonids. Given the 10-year timeframe for the proposed work, a huge opportunity would be lost if some basic population metrics were not measured along with the flow and habitat characterizations. Even if no response to the augmentation were detected, such data would at least provide baseline information about annual variation in recruitment, which could inform future experiments.

5. Are the hypotheses to be tested clearly stated?

Generally yes, but the authors should more explicitly incorporate relevant timeframes into hypotheses. That is, over what timeframe should a particular hypothesis be evaluated?

6. Is the conceptual study design component appropriate?

Generally yes, but the design lacks sufficient attention to annual and seasonal variation. I suggest that habitat characterizations be conducted for a minimum of 2 years prior to augmenting flow so that background variance in habitat can be estimated. In addition, seasonal variation in certain habitat conditions may be critical for salmonids and should be characterized before the experiment begins.

7. Will the conceptual monitoring/data gathering program answer the questions posed by the hypotheses?

Generally yes, but considerably more monitoring of fry and juvenile salmonids and of introduced fishes is needed to properly interpret the outcome of the proposed experiment and to inform future ones.

Miscellaneous comments:

Please provide an overall evaluation summary rating below.

Recommended for full proposal development

Provide a brief explanation of your summary rating:

I recommend this concept proposal for full development. There is considerable room to improve the ideas/approaches presented here but a great deal to be learned by going forward with the proposed augmentation.

Conceptual Proposal Review Form (External Science Review) CBDA Environmental Water Program

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Proposal Title: Environmental Water Program Conceptual Proposal for Flow Acquisition on Lower Clear Creek

Reviewer: Peter B. Moyle

External Science Review Questions

1. Is the justification for flow augmentation clearly stated?

Yes

2. Are the goals and objectives clear and reasonable?

Yes – exceptionally so

3. Is there a clear conceptual model to support the proposed action?

Yes

4. Are the key assumptions and scientific uncertainties explained?

Yes- In reality they are endless but the key ones seem to be there

5. Are the hypotheses to be tested clearly stated?

Yes- I like the table format; there are a few more that probably should be on the list (see comments)

6. Is the conceptual study design component appropriate?

Yes if your question refers to the experimental study design section.

7. Will the conceptual monitoring/data gathering program answer the questions posed by the hypotheses? **Yes but more may be needed...**

Miscellaneous comments: See next page for specific comments

Please provide an overall evaluation summary rating below.

Recommended for full proposal development

Provide a brief explanation of your summary rating:

This is the best proposal for a large-scale restoration project I have seen. It does an excellent job of meeting the spirit and realities of the demands of the ERP Science Board for a restoration project. This could be a model for other project designs. Some general comments:

1. I would have liked to see a bit more on the relationship of this project to areas downstream of Clear Creek and other restoration projects. This is probably impossibly difficult, given all the uncertainties, but (for example) there might be more flexibility in riparian restoration objectives if the restoration was in conjunction with other nearby projects.
2. The project is a bit too Salmonid Centric for my taste, even though I understand the reasons for this. The project could still be regarded as a success even if salmonids did not come roaring back in huge numbers, if other native fishes became more diverse and abundant (which the flow regime is likely to promote). This could easily be incorporated into the goals & hypotheses and would not require much (any?) additional expense.
3. The success of restoration seems closely tied to gravel augmentation, which is likely to become increasingly expensive (both absolutely and relatively) as time goes on. It seems to be, in the era of unreasonable budget cuts, that a conceptual model without gravel augmentation would be worth including. It may be that under this scenario, restoration of other native fishes would become more of a goal.
4. I think more attention could be paid to bird and mammal surveys as part of the monitoring plan, and not just species that are on agency lists as being in decline. Breeding and migratory bird surveys should be part of the monitoring, as should mammal monitoring (including charismatic forms and bats). I realize that another box might spoil the symmetry of the conceptual model diagrams but a "terrestrial fauna" box would seem appropriate.

Additional comments

1. p. 11. *Lavinia exilicauda* Also: no need to mention racist name “digger” pine because the scientific name is presented.. Another alternative name is foothill pine (others prefer ghost pine).

2. p. 12. Table 4. Hardhead are CFG species of special concern

3. p. 14. See Moyle (2002) or Moyle et al. (2004) for more up to day information on splittail. I doubt they were ever abundant in Clear Creek although they may have moved up in fall to feed on salmon eggs. Most likely cause of decline is shortage of floodplain habitat.

It is possible that brook lamprey are still present; they have to be looked for. River lamprey were probably never very common; even presence is problematical (too far upstream).

4. P 15. Restoration of floodplains should be for more than just trees. Salmon use it as well and a mosaic of habitats is probably better for salmon and for diversity of use.

Wildlife: I realize that the most attention has to be paid to endangered species but charismatic wildlife of poorly understood status that would benefit would also be worth mentioning (e.g., ringtailed cat, otter, mink, black bear). Ideally, they should be monitored as well. Statement on p 23 is rather vague.

P21 Is there a source of LWD upstream in the watershed or will it be entirely cottonwoods? Problem acknowledged on P. 26 but not fully addressed. The models indicate it will have to be added. Source?

P22. Don't be so certain that bullfrogs cannot survive high winter flows; I have observed large numbers of tadpoles surviving very high flow events in Putah and Dye creeks. Like small salmon, they can find backwaters or burrow into the substrate. What bullfrogs need is quiet, warm backwaters in summer, unfortunately redlegged frog habitat! Bullfrogs may require active control (e.g. shooting adults).

P23 Impacts on non-native mammals? Rats, muskrats, etc.

P28 Goal #3 should recognize importance of floodplains to organisms other than birds and trees. I think this is implicit in the goal, but a mosaic of habitats is clearly desirable, including areas dominated by annual vegetation. This implies a very active floodplain; may be difficult to do with flows alone. I recognize that this may be too much to ask for Clear Creek alone, so ideally the floodplain should be managed in conjunction with other restored areas downstream.

P33 Assumption throughout is that gravel augmentation will continue. What if it does not?

P34 would a conceptual model showing a flows-only scenario be worth doing? Gravel augmentation is going to become increasingly expensive.

P 41. Consider adding hypothesis that flow changes will increase the abundance and diversity (# of species) of native fishes aside from salmon and decrease the abundance and diversity of alien species. This hypothesis is less dependent on 'outside' events than salmon abundance. Note that there is the possibility of introduction of Trinity River/Whiskeytown Res. fishes to the creek/Sacramento River.

P41 Shouldn't there be a hypothesis related to riparian birds?

P44 and elsewhere. Whiskeytown Res and Lake are used interchangeably. Stick with reservoir as the best time, even if the builders and local C of Cs prefer "lake." It is not a lake.

P48-49 Costs: I assume this is cost in 2004 dollars. Should be stated.